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AUTHOR Isakson, Marne; Moore, J. William
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ABSTRACT

The purpose of this research was to determine if training in analytic processing would increase the probability that subjects behaving impulsively prior to training would behave more reflectively following training. The study attempted to alter impulsive behavior in terms of number of errors by training identified impulsive boys to use component parts of stimuli. The pretest, a modified version of the Matching Familiar Figures (MFF), was administered to 34 second grade boys; three sets of materials were used to train these subjects in analytic relationships, detail recall, and detail matching. Results indicate that pupils classified as impulsives can, through training in analysis, be conditioned to behave more reflectively in terms of reduction of errors, and that training in analysis under conditions where time is allowed to vary does not lead to an increase in responding time. References and test figures are included. (Author/SES)

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The Effects of Training of Analysis upon the Responding Style of Impulsive Children

Marné Isakson and J. William Moore
Bucknell University

CG 007 419

Evidence supports the conclusion that an impulsive responding tempo is detrimental to successful experiences in the many school tasks requiring analytic processing of information. (Kagan, 1965a, Kagan, 1965b, Kagan 1966, Kagan, Pearson & Welch, 1966; Kagan & Rosman, 1964; Kagan, Rosman, Day, Albert, & Phillips, 1964; Barratt, 1959, Train, 1957, Ward, 1968). Because of the disadvantage, attempts have been made to alter the impulsive tempo to a more reflective one. Attempts have been somewhat successful in altering aspects of impulsive responding, namely, by lengthening response time (Kagan et al., 1964; Kagan et al., 1966, Yando & Kagan, 1968). A hypothesis was that training the impulsive responder to take more time would result in reduction of errors. This did not occur. The major disadvantageous aspect of impulsivity, many errors, was not altered in the studies. It was the present writer's contention that what impulsive responders needed in order to reduce errors was to learn to use detail, that is, to process information analytically.

Studies demonstrated stability of impulsivity and reflectivity over time and tasks, and demonstrated predictions of performance based on impulsive or reflective responding (Kagan et al., 1964). An impulsive responder is one who is above the mean in number or errors and below the mean in length of response time when given a task involving one correct choice from a number of alternatives. That is, he makes many errors in a short period of time. Conversely, the reflective responder makes few errors in a long period of time.

The impulsivity-reflectivity dimension has an impact upon learning and social adjustment (Kagan et al., 1966, Kagan, 1965a, Kagan, 1965b, Kagan, 1966, Ward, 1968). The reading retarded child is more prone to be impulsive and his inferior performance is frequently the result of impulsivity.

In a study on impulsivity-reflectivity and reading ability in the primary grades (Kagan, 1965b), a positive correlation was found between measures of impulsivity given the beginning of first grade and reading errors one year later. Impulsive children, as differentiated from reflective children, tend to make more errors in reading during the primary grades, are more likely to come to incorrect solutions on inductive reasoning problems and visual discrimination tasks, and make more errors of commission on serial recall tasks (Kagan et al., 1966b). Impulsivity-reflectivity affects the manner in which external information is classified and organized; and, therefore, it affects the quality of the final response.

Impulsivity may be detrimental to learning because it: contributes to reading problems (Kagan, 1965b); leads to underdeveloped discrimination capacity; impedes development of an atttiude giving importance or gravity to situations (Train, 1957); habituates careless responses; leads to underdeveloped ideas; reduces the probability of the analysis or relationships, conditions, and outcomes; and increases the probability that some relevant aspects of the situation may not be processed. Other disadvantages of impulsivity may be that the child becomes dependent on direct feedback from others rather than looking to the environment for cues; the impulsive child displays more restlessness and greater distractibility which can hinder concentration and performance (Kagan et al., 1964, Study Eight; Barratt, 1959; Kagan & Rosman, 1964; Train, 1957): he, perhaps, comes to answers by the process of elimination rather than by comprehension of them; and he appears to be more concerned about responding than with the quality of the response. Each of the above statements could be involved in a separate study to determine the effects of impulsivity upon learning. Yet existing evidence suggests that impulsivity is a disadvantage in a learning process requiring analytic thinking.

Several attempts were made to modify impulsive behavior to more reflective behavior. The attempts can be categorized under two approaches, modeling and forced delay in response time. The scant evidence on the modeling effects in altering impulsivity favors long term contact with the reflective model in lengthening response times but not in reducing errors (Kagan et al., 1964, Study Six; Kagan et al., 1966; Yando & Kagan, 1968). Research results are equivocal on the effects of forced delay of response time in altering impulsive behavior. The technique appeared to be effective in terms of lengthening response time but not in the reduction of errors (Kagan et al., 1964, Study Two; Kagan et al., 1966).

The major postulate of the present study was that impulsives needed training in analysis to reduce errors on tasks requiring analytic processing. Lengthening response time was not enough.

Studies on reflective behavior showed that reflectivity is highly coorelated with analytic modes of information processing (Lee, Kagan & Rabson, 1963; Kagan, Moss & Sigel, 1963; Kagan et al., 1964, Studies One through Five). Could not training the impulsive child to process information analytically lead to more reflective behavior? Could not impulsive behavior be altered by training the child to attend to details? This was the major question asked in the present study. It seemed reasonable that if the impulsive child learned to see and use details in tasks requiring such activities, his error score would drop since correctness is dependent upon use of details. His response time might increase as well, but if it did not, it would be of little matter since decrease in errors would be the prime objective. The ideal responding style, after all, is a fast response time with no errors.

The present study attempted to alter impulsive behavior to more reflective behavior in terms of number of errors by training identified impulsive boys to use component parts of stimuli. The effects of training were

measured on a task having one correct answer among a number of alternative answers. It was also hypothesized, because of studies showing a positive correlation of analytic processing with increased response time, that training in analysis would result in lengthened response time.

Hypotheses

1. The experimental group makes fewer errors on the posttest than the control group.
2. The experimental group has a greater latency to first response on the posttest than the control group.

Method and Materials

Subjects

Thirty-four second-grade boys were selected from among 119 who had received the Matching Familiar Figures (MFF) as a pretest. The Ss were above the mean in numbers of errors and below the mean in response time. IQ scores were gathered.

Materials

The pretest was a modified version of the MFF developed by Kagan, Rosman, Day Albert, and Phillips (1964). It consisted of a standard and six alternatives, only one of which matched the standard. Twelve arrays were prepared. (See Figure 1.)

Subjects in the experimental group were trained with three sets of materials. The first set was used in the Analytic Relationship Training (ART). The set was similar in structure to the Conceptual Style Test developed by Jerome Kagan and his associates (1963, 1964, 1965a). It consisted of a set of 27 cards, each with three black and white drawings of familiar objects. Any combination of two objects could be related in one or more ways. The possible relationships have been classified into

three concept classes (Kagan et al., 1964): functional, categorical, and analytical. (See Figure 2.) The materials for Analytic Relationship Training were chosen because Ss could be trained to discriminate analytic relationships from other relationships, thereby, learning to compare component parts of two objects. The training of the initial focus upon detail was the first step in training perception of detail.

The second set of experimental materials was a set of 12 photographs from magazines and so were very complex in details. Six questions per picture testing the child's perception of detail were on the back of each card. Each question was structured to elicit a single word response. Examples of the types of questions asked were: Is the baby holding onto the father? Are clean diapers and diaper pins lying on the side of the sink? This task was Detail Recall Training (DRT). The materials for DRT were chosen as a tool for training the child to scan and remember the parts of complex stimuli. The questions were of such a nature that only deliberate study of the parts of the picture could assure correct answers.

The third set of experimental materials consisted of 15 drawings traced from a Walt Disney coloring book and mounted on cards (See Figure 3). Parts of most drawings were shaded. A detail from a drawing and three distracting details were put together to make an array of four similar details only one of which matched the detail in the actual drawing. This array was mounted on a card and taped to the back of the drawing. Shape, shading, and size were the variables from which the alternatives differed from the correct detail. Three arrays were constructed for each drawing. The task involving the third set of materials was the Detail Matching Training (DMT). It was designed for the purpose of forcing attention to details, of training memory of detail, and of requiring precise discrimination involving those details. Close scrutinization of details was required for achievement at

the task.

Subjects in both the experimental and control groups received a modified form of the Matching Familiar Figures as a posttest. The basic structure of the test was the same as the pretest except that ten alternatives were presented per standard. Subjects received 12 arrays.

Procedures

Pretest.--- Subjects were individually administered the Matching Familiar Figures (MFF). The Ss were required to point to the figure in the array which matched the standard for each of 12 items. Ss were randomly assigned to two treatment groups: experimental group that received training in analysis and the control group that colored pictures. Ss were met individually for 20 minutes a day.

Experimental Group.---Ss received three phases of training in a sequential order. The task for each phase had a set criterion which had to be met before the next tasks were introduced. These criteria are followed by an asterisk* in the discussion which follows. THE Ss were met individually for the number of twenty-minute sessions needed to complete the training. Ss took four or five training periods.

Phase I. Analytic Relationship Training.--- Subjects were shown cards with three figures on them. Any two of the figures could be related by one or more of three relationship types; analytic, categorical, functional. Analytical is the relationship in which parts of one figure are compared to parts of another figure. Categorical is one in which two of the figures are samples from some alrger classification, such as musical instruments. Functional is one in which one of the figures acts upon another; they "function" together in some way. (See Figure 1).

Phase One (ART) involved three steps. In all three the child was verbally rewarded for describing analytic relationships and was not rewarded for any of the other relationships. Step One. To get S initially to be aware of the desired analytic response, E held up one card and said "Here is a card with three pictures on it. I am thinking of a special way that two of these pictures are alike. I will tell you three possible ways and then you try to guess which one I am thinking of." E then described pictures in terms of the relationships and the child guessed. If he guessed the analytic relationship, he was verbally rewarded. If S were incorrect, E said, "No, that isn't the way I was thinking. The one I wanted you to pick was this one." The E pointed to and described the analytic relationship. This procedure was continued until S could name the analytic relationship three cards in succession.* Step Two. "Now instead of my naming any of the ways the figures are alike, you describe for me on your own the special way." Verbal rewards were given for analytic relationships. If the analytic relationships were not named on a second try, it was pointed to and described. The procedure was continued until S could name analytic relationships on the first try for three consecutive cards.* Step Three. E said, "You have done very well so far. You have been asked to find the special way the figures are alike. But there can be many of these special ways on each card. Here is an example." E pointed to five or six analytic relationships on one card. The S proceeded until he could name two in a row per card for three consecutive cards.*

At the beginning of the session following completion of all three steps of ART, E had S meet the criteria a second time for Step Two and Step Three. In summary, for a child to reach the criterion of Phase One, Two, Three plus on the following day have met again the intermediate criteria of Steps Two and Three.

Phase II. Detail Recall Training.---The task consisted of showing Ss a series of pictures one at a time. S was told to study the parts of the picutre. It was then removed and he was asked two questions. If they were answered correctly, the next picture was presented. If one or both were missed, the picture was shown again so S could find the right answer. After more study he was asked two more questions. The treatment continued until criterion was reached. The criterion was to answer one set of two questions correctly per picture for three consecutive pictures.*

As with Phase One, Ss had to meet criterion a second time the day after the first criterion had been met.

Phase III. Detail Matching Training.--- Ss were shown drawings from a coloring book. After S studied the drawing, it was removed and he was shown one detail with three distracters. He was to identify the detail that matched the one in the drawing. If he selected a distracter, he was permitted to study the drawing again to find the right answer. Each S received all three detail arrays for each card. He continued until he had reached the criterion which was no more than one wrong answer per detail for each of three consecutive drawings.*

Posttest.--- The day after training was completed for both groups, the Ss received the posttest preceded by a brief warm-up. The MFF was administered individually to Ss in both groups. Latency to first response to the half-second, number of errors, and the order in which they occurred were recorded. This posttest measured the dependent variables of time and errors.

Data Analysis

Data were analyzed with four tests: a two-way, unweighted-means ANOVA on time with treatment and school as the independent variables, a two-way, unweighted-means ANOVA on errors also with treatment and school as the

independent variables, an ANCOVA on the dependent variable of time using IQ as the covariate, and an ANCOVA on numbers of errors also using IQ as the covariate.

Results

A two-way, unweighted-means analysis of variance on error scores on the posttest showed significant differences between treatment groups ($F=3.66$, $p<.10$). Ss in the experimental group made fewer errors than Ss in the control group. Scores were blocked on treatment and schools. No significant differences were found for schools nor for the interaction of school and treatment. The summary table for the analysis of variance is presented in Table 1.

TABLE 1

Unweighted-Means Analysis
of Variance for Errors

Source	SS	df	MS	F
Schools (A)	474.485	4	118.62	.785
Treatments (B)	553.416	1	553.42	3.662*
A X B	265.205	4	66.30	.439
Within cell	3324.5	22	151.11	

*$p<.10$

The results of a two-way, unweighted-means ANOVA on response time showed no significant effect of treatment upon posttest response time, no significant effect of schools upon response time, and no significant interactions between treatment and school upon response time. Table 2 is the summary table for the analysis of variance.

TABLE 2

Unweighted-Means Analysis
of Variance for Time

Source	SS	df	MS	F
Schools (A)	6254.9	4	15636.98	1.53
Treatments (B)	74.06	1	74.06	.007
A X B	56269.62	4	14067.41	1.38
Within cell	224836.49	22	10219.84	

Analyses of covariance were performed to determine treatment effects when IQ is factored out as a source of variance. The requirement for homogeneity of regression in the analysis of covariance was met ($F=.0497$, $\underline{9}<.10$). Table 3 is the summary for the analysis of covariance on the posttest error scores. Treatment differences were significant ($F=11.76$, $\underline{p}<.005$). The experimental Ss made fewer errors than the control Ss.

TABLE 3

Analysis of Covariance
for Effors,
IQ - Covariate

Source	SS	df	MS	F
Treatments	746.236	1	746.236	11.76*
Error	1205.522	19	63.449	
Total	1951.758	20		

*$\underline{p}<.005$

Table 4 presents ANCOVA for response time as the variable and IQ as the covariate. No treatment effects were significant.

TABLE 4

Analysis of Covariance
for Latency to First Response
IQ - Covariate

Source	SS	df	MS	F
Treatments	10662.34	1	10662.34	2.246
Error	90193.52	19	4747.03	
Total	100855.86	20		

The first hypothesis that training in analysis would reduce errors was supported, but the second hypothesis that training in analysis would increase response time was not supported.

Discussion

The basic purpose of the present research was to determine if training in analytic processing would increase the probability that Ss behaving impulsively prior to training would behave more reflectively following training.

Because of the significant training effect on the reduction of errors, it was concluded that the postulate that attention to details does increase accurate performance in a problem solving situation is tenable. This finding supported the suggestion made by Kagan and his associates that impulsive children need training in visual analysis (Kagan et al., 1964; Kagan et al., 1966; Yando & Kagan, 1968). Explanations for the effect that training in visual analysis had in reducing errors may be that: it developed scanning strategies, improved visual detection, developed awareness of parts and of

their relationships to each other, developed attention to the relevant parts, improved discrimination abilities and the ability to detect inconsistencies, contrasts, and similarities.

The results did not support the hypothesis that training in analysis would increase response time. An explanation for this was that time was purposely allowed to vary during training because of the contention that impulsives make errors not because they respond more rapidly, as hypothesized in previous investigations, but because they lack the skill to use the information given them.

Because reduction in errors did occur without a corresponding increase in time, it was concluded that response time and errors are independent. Though delayed time has been shown to be associated with accuracy, previous studies showed change in response time without changing the number of errors made (Kagan et al., 1964; Kagan et al., 1966). The present study showed that differences in numbers of errors can occur without differences in response time. Response time and errors appear to be independent.

Rather than being dependent on response time, reduced errors in a problem solving task appeared to be a function of analytic skill. The results of previous studies showing no reduction in errors when time was controlled could be due to Ss not being trained to use the information given them as suggested by the present findings.

The findings that training in analysis leads to reduced errors but does not lead to an increase in response time generated a number of conclusions and implications. One conclusion is that impulsives lack analytic skill. This supports the work of those who found analytic abilities more prevalent in reflective children (Kagan et al., 1964, Studies One through Five; Lee, Kagan & Rabson, 1963; Kagan, Moss & Sigel, 1963). Another conclusion is

that the two-category classification of impulsivity-reflectivity may be inadequate. The present study suggested that a third category of behavior exists involving the best of both impulsive and reflective behaviors, i.e., low errors with short response time. Conversely, a fourth category would be the worst of both, i.e., many errors with long response time.

Another conclusion was that nonanalytic behavior can be modified through training. An implication of this is that training in analytic processing as a part of the regular teaching routine would help the nonanalytic child develop the necessary analytic skills. Certainly his inability to analyze parts need not be retained if sequenced training in analytic processing is provided.

Recommendations for further research include studying the extent to which errors and time are reduced as a function of a number of variables such as sex, IQ, and socio-economic status. Future research could study the underlying principles of analytic processing so that effective, sequenced training materials can be developed. Further research could be conducted on the cues to which impulsive and reflective children attend as they process information. Questions could be studied such as the number of cues used, the number of hypotheses generated, the attending time, etc. Another question could deal with the actual scanning strategies used.

Since visual perception is vital in the beginning reading process and since some children display consistent impulsive behavior, an outgrowth of this study could be work in exploring relationships between cognitive style and reading skills.

One question to be answered by further research is this: Can the use of analysis training in combination with training for reducing response time result in reduction of errors for impulsive and reduction of time for reflectives?

Other questions to be answered by further research are: (a. How does visual analytic skill correlate with analytic skill in the other sense modalities? (b. How is impulsivity initially conditioned? (c. What are the effects of impulsive or reflective responding upon school performance, teacher and peer acceptance, and self-concept?

In summary, the major conclusions of the study were that pupils classified as impulsives can, through training in analysis, be trained to behave more as pupils classified as reflectives in terms of reduction of errors and that training in analysis under conditions where time is allowed to vary does not lead to an increase in responding time.

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Figure I
Sample from Matching
Familiar Figures –
Pretest

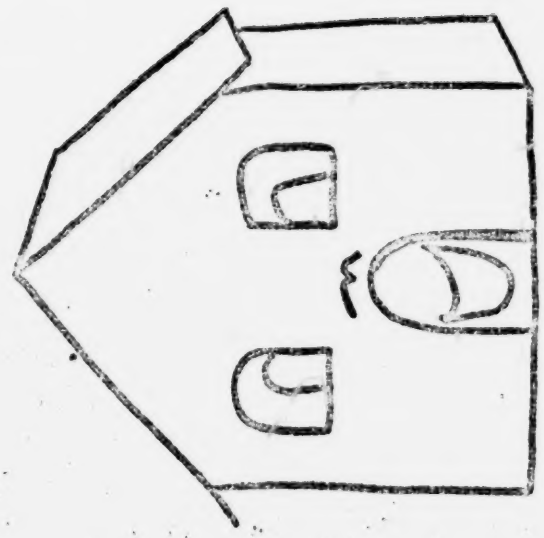
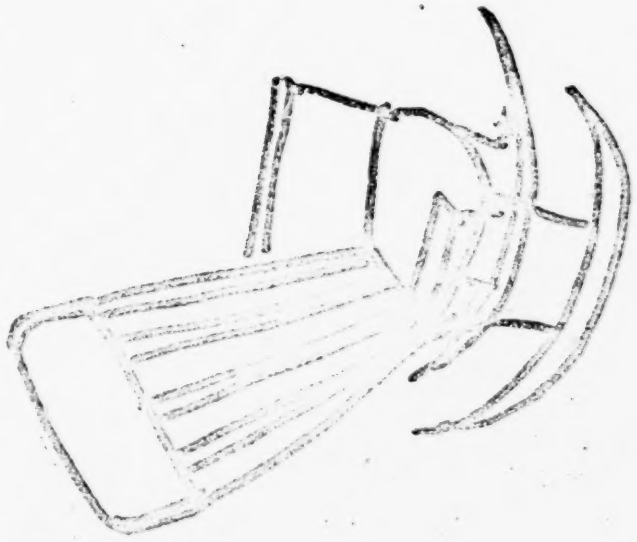


Figure I --continued

Figure II - Sample from Analytic Relationship Training

A. Bars of jail and bars of rocker
B. Grandmother knits in rocker.
C. Man and grandmother are people



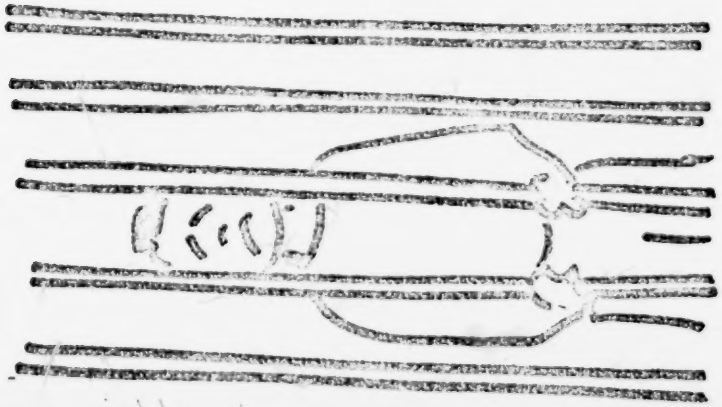


Figure III - Sample from
Detail Matching Training

Figure III -- continued